AD-A271 878

COAM

Center for
Ocean & Atmospheric
Modeling

Building 1103
Stennis Space Center
Mississippi 39529

Phone 601-688-5737
FAX 601-688-7072

PROCESSING OF CLIMATOLOGICAL DATA FOR MODEL INITIALIZATION

Germana Peggion

Grace Foo

The University of
Southern Mississippi

TM-2/94
October 1993

The Center for Ocean & Atmospheric Modeling (COAM) is operated by The University of Southern Mississippi under sponsorship of the Department of the Navy, Office of the Chief of Naval Research. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the position or the policy of the U.S. Government, and no official endorsement should be inferred.

This work is under the Basin Dynamics and Regional Data Assimilation project.

ABSTRACT

This document describes and documents a numerical procedure to compile data sets to be applied in the North Atlantic (NA) basin-wide numerical simulations. The specific objectives are:

1) to acquire climatological data sets for the NA, and archive them on a data library.

2) to develop an interpolation procedure for 2-D, and 3-D data fields from a regular grid into the generalized coordinate system adopted by the ocean models.

3) to prepare plotting facilities for the display and presentation of the original and interpolated data sets.

The numerical programs described by this document and the user's manual associated with them were developed and implemented by Ms. Grace Foo, a PhD student in the Scientific Computing Program at USM, and part-time research assistant with COAM.

1. INTRODUCTION

Under ONR Grant No. N00014-92-J-4112, The Center for Ocean & Atmospheric Modeling (COAM) at The University of Southern Mississippi (USM) has undertaken a scientific program to develop an ocean prediction system with emphasis in the North Atlantic that connects a basin-wide, eddy-resolving model with regional models incorporating data assimilation procedures to provide the requested forecasting ability in selected areas. An essential part of the project is also to evaluate new physical/numerical formulations that take advantage of the advancing computer technologies and are suitable for basin-wide, eddy-resolving ocean circulation simulations.

Two are the models that COAM will evaluate and apply to the prediction system: The S-Coordinate Rutgers University Model (SCRUM), and the Spectral Finite Element (SFE) model, both designed and developed by Prof. D. Haidvogel and his colleagues at Rutgers University.

To construct a robust operational prediction system, it is necessary to perform extensive sensitivity and calibration studies to evaluate the numerical efficiency and physical accuracy of the models. Moreover, both SCRUM and SFE, being recently released, are lacking a background of testing under different dynamical regimes. Therefore, there is a need to design a series of preliminary experiments in which different physical/numerical issues can be isolated easily and investigated separately.

This document is focused on the initialization for such preliminary simulations and describes the interpolation procedure from climatological data into SCRUM grid configurations. The initialization procedure for the SFE model is under implementation. Climatological data are usually on a coarse but regular grid that removes most of the mesoscale signals and destroys small-scale features; SCRUM uses an orthogonal curvilinear coordinate system which conforms to the irregular coastal boundaries and a generalized vertical

coordinate transformation that follows the bottom topography. Numerical experiments will be necessary for generating a numerical grid suitable for the assessment of the basin-wide, eddy-resolving model. Thus, the issue is to implement an interpolation package that can be applied easily, is numerically efficient, yet preserves the dominant features of the original data sets.

This document describes and documents a numerical procedure to compile data sets to be applied in the North Atlantic (NA) basin-wide numerical simulations. The specific objectives are:

1) to acquire climatological data sets for the NA, and archive them on a data library (NADL).

2) to develop an interpolation procedure for 2-D and 3-D data fields from a regular grid into the generalized coordinate system of the SCRUM and SFE grids. This group of programs also constitutes the initial kernel for the development of a library of utility programs (NAUL)to be used in connection with the North Atlantic ocean prediction system.

3) to prepare plotting facilities for the display and presentation of the original and interpolated data sets.

2. NORTH ATLANTIC DATA LIBRARY (NADL)

The Levitus annual mean of temperature, T, and salinity, S, and the Hellerman wind stress data sets constitute the first kernel for the North Atlantic Data Library (NADL). The library will contain data files covering the region extending from 20°S (to include the Tropical Convergence Zone (TCZ)) to 75°N (the Fram Straits) from 110°W to 20°E (from American to European/African coasts) (Fig.1).

The extracted data sets are usually reformatted according to the standards defined for the NADL. The NADL is intended for the sole internal use of the group engaged in the development of the ocean prediction syestem. It has not been conceived as a facility to be accessed by a wide number of users.

3. THE INTERPOLATION PROCEDURES

The Hellerman and Levitus data sets are representative of 2-D vectorial and 3-D scalar data fields, respectively. The different nature of the original data sets leads to different issues and approaches in the interpolation algorithms, as discussed in the following sections. The results are presented for the SCRUM grid illustrated in Fig. 1. However, the interpolation procedure is independent of the grid configuration. Information relative to the model domain are extracted from the files generated by the grid generation package developed by Hedstrom and Wilkins (User's manual, in preparation) and supported by Prof. D. Haidvogel as part of the SCRUM and SFE models. Thus, the algorithms described in this document can be applied also to the SFE model with minimum changes in the input file requirements.

3.1. The 2-D Vector Field Interpolation Procedure

Hellerman winds are interpolated on two steps as follows:

1) perform a 2-D horizontal scalar interpolation of the (x,y) (i.e, longitude, latitude) wind components. The interpolation is done using the bilinear algorithm developed by Dr. D.-S. Ko (Aug. 1989), and included in the North Atlantic Utility Library (NAUL).
2) perform a rotation of the axis such that at each grid point the wind components are referred to the orthogonal, boundary fitted (ξ, η) coordinate system of SCRUM.

The annual mean Hellerman wind in the subdomain stored in the NADL and the associated interpolated field are depicted in Figs. 2. and 3., respectively. As Figs. 2. and 3. indicate, the program changes the wind stress units. The Hellerman wind stresses, (τ_x, τ_y), are referred on CGS units (dyne/cm^2); on the other hand, SCRUM uses MKSA units and takes $(\tau_x, \tau_y)/\rho_o$. Thus, a scale factor is introduced to make the data consistent with the model requirements.

Five programs are used to process/plot the wind data:

1) **w3.f** (prepare data set for NADL)
2) **r2.f** (prepare numerical grid coord file)
3) **bilw.f** (interpolate onto numerical grid)
4) **wl1.f** (plot selected Wind data)
5) **wi1.f** (plot interpolated Wind field)

3.2. The 3-D Scalar Field Interpolation Procedure

The Levitus annual mean of temperature and salinity are interpolated on the following steps:

1) perform a 2-D extrapolation of the Levitus data over the whole NA region of the NADL. Extrapolation is done using the ZGRID algorithm developed by J. Taylor et al. (1971).
2) perform a 2-D horizontal bilinear interpolation of T and S data fields at each z-level of the original Levitus data set.
3) perform a 1-D vertical interpolation at each (ξ, η) point on the numerical grid. The interpolation is done using a cubic spline algorithm from Numerical Recipes (W. H. Press et al.,1986).
4) compute the density field associated with the T, and S data distributions. Density is computed from the UNESCO '80 equation of state (Millero and Poisson, 1981).

The 2-D horizontal interpolation is in two steps because of the coarseness of the Levitus data, and the misfit between the numerical grid boundaries and the geographical coastlines. The extrapolation over the NA box guarantees that not many undefined data points are close to the boundaries of the numerical grid and facilitates application of the bilinear interpolation algorithm.

The separation between horizontal and vertical interpolation has been suggested to accelerate studies of the sensitivity of the model to the vertical grid resolution (i.e., we expect to conduct several experiments configured in the same horizontal grid but with different vertical structure). The 2-D interpolated temperature, salinity, and density at selected z-levels are depicted in Fig. 4.

The vertical interpolation algorithm requires the definition of the depth at each numerical grid point and can be applied easily to any general vertical coordinate transformation adopted by the ocean circulation model.

It is known that in a generalized vertical coordinate system, s, conforming to the bottom topography, computation of the pressure gradient forces are complicated and might introduce sensible errors in the evolving solution (Haney, 1991). In order to improve the model performance, it is customary to decompose the density, ρ_{Tot}, and the constituent T_{Tot}, and S_{Tot} as follows:

$$\rho_{\mathrm{Tot}} = \rho\mathrm{bar}(z) + \rho(\xi, \eta, s, t)$$

$$T_{\mathrm{Tot}} = T\mathrm{bar}(z) + T(\xi, \eta, s, t)$$

$$S_{\mathrm{Tot}} = S\mathrm{bar}(z) + S(\xi, \eta, s, t)$$

where $z = z(\xi, \eta, s)$, ρbar, Tbar, and Sbar represent the state of the quiescent ocean, ρ, T, and S the perturbated fields.

To augment the accuracy of the density and pressure forces computations and increase the stability of the model, it is necessary to ensure that the perturbated density is weakly stratified with respect to the basic state. Since the problem is associated with the numerical rather than the physical formulation of the ocean model, the basic state is defined as the mean value of the total field distributions at each given z-level. (Since the equation of state is not linear, ρbar cannot be computed from Tbar and Sbar, directly). Thus, in performing the 2-D interpolation, the algorithm also computes the mean values for the definitions of the basic state. Fig. 5. illustrates the basic state of the quiescent ocean relative to the numerical grid.

The numerical algorithm for the computation of the density field also includes a routine to verify that the density field is stable stratified, and eventually performs a vertical mixing of the constituent fields.

Five programs to process the Levitus data:

1) **gll1.f** (prepares input data coordfile)
2) **zgi.f** (extrapolation of input data)
3) **bilt.f** (interpolates onto numerical grid)

4) **rhl.f** (computes density field)

5) **vitl.f** (performs vertical interpolation)

Five programs to plot Levitus data:

1) **tl1.f** (plots Levitus data on the NA domain at a given z-level)

2) **til.f** (plots interpolated 2-D data at a given z-level)

3) **cil.f** (color plots of 2-D interpolated at a given z-level)

4) **dts.f** (plot vertical profile of the basic state)

5) **tsl.f** (plots T-S diagram)

4. PLOTTING FACILITIES

Plotting facilities are for the display and presentation of the data sets and have been described in the previous sections. Plots are made using NCAR Graphics software. The plotting utilities include options for color graphics (not presented in this document) and display of T-S diagrams. The latter facility is for a preliminary evaluation of the water masses present in the data sets, to trace their evolution according to the model solution. Fig 6. displays the T-S diagram of the upper 50m.

5. CONCLUSIONS

The Hellerman's wind and Levitus climatological data sets were acquired and processed for preliminary evaluations of an eddy-resolving ocean circulation model for the NA.

The goal is to implement an interpolation package that can be applied easily, is numerically efficient, yet preserves the dominant features of the original records. The new processed data sets are part of the initial conditions and forcing mechanisms to be appled in numerical experiments that will verify the physical accuracy and numerical efficiency of the models.

REFERENCES

Haney, R.L.; 1991: On the pressure gradient force over steep topography in σ coordinate ocean models. *J. Phys. Oceanogr.*, **21**, 610-619.

Hellerman, S. and M. Rosenstein; 1983: Normal monthly wind stress over the world ocean with error estimates. *J. Phys. Oceanogr.*, **13**, 1093-1104.

Levitus, S.; 1982: *Climatological atlas of the world ocean.* NOAA Prof. Paper 13, U.S. Govt. Printing Office, Washington, D.C., 173 pp.

Millero, F.C. and A. Poisson; 1981: International one-atmosphere equation of state of seawater. *Deep Sea Res.*, **27A**, 255-264.

Press, W. H,, Flannery, B.P., Teukolsy, S.A., and W.T. Vetterling; 1986: *Numerical Recipes*, Cambridge University Press, Cambridge, Ma, 818pp.

Taylor, J., Richards, P., and R. Halstead; 1971: *Computer routines for surface generation and display.* Dept. of Energy, Mines, and Resources. Marine Sciences Branch. (Manuscript Report Series, 16). Ottawa, Canada.

FIGURES

1) The North Atlantic domain for the NADL, and the orthogonal boundary fitted numerical grid used in this document.

2) The Hellerman annual wind original data: (a) The longitude (x) component; (b) the latitude (y) component; (c) the wind stress vector directions and magnitude.

3) The Hellerman annual wind interpolated data. Same as Fig. 2.

4) The 2-D interpolated Levitus data at the z-levels: 50, 500, 1000 m.: (a) temperature; (b) salinity, and (c) density.

5) The basic state of the quiescent ocean over the numerical grid.

6) The T-S diagrams of the upper 50m.

7) The diagram of the files generated by the interpolation packages.

NORTH ATLANTIC

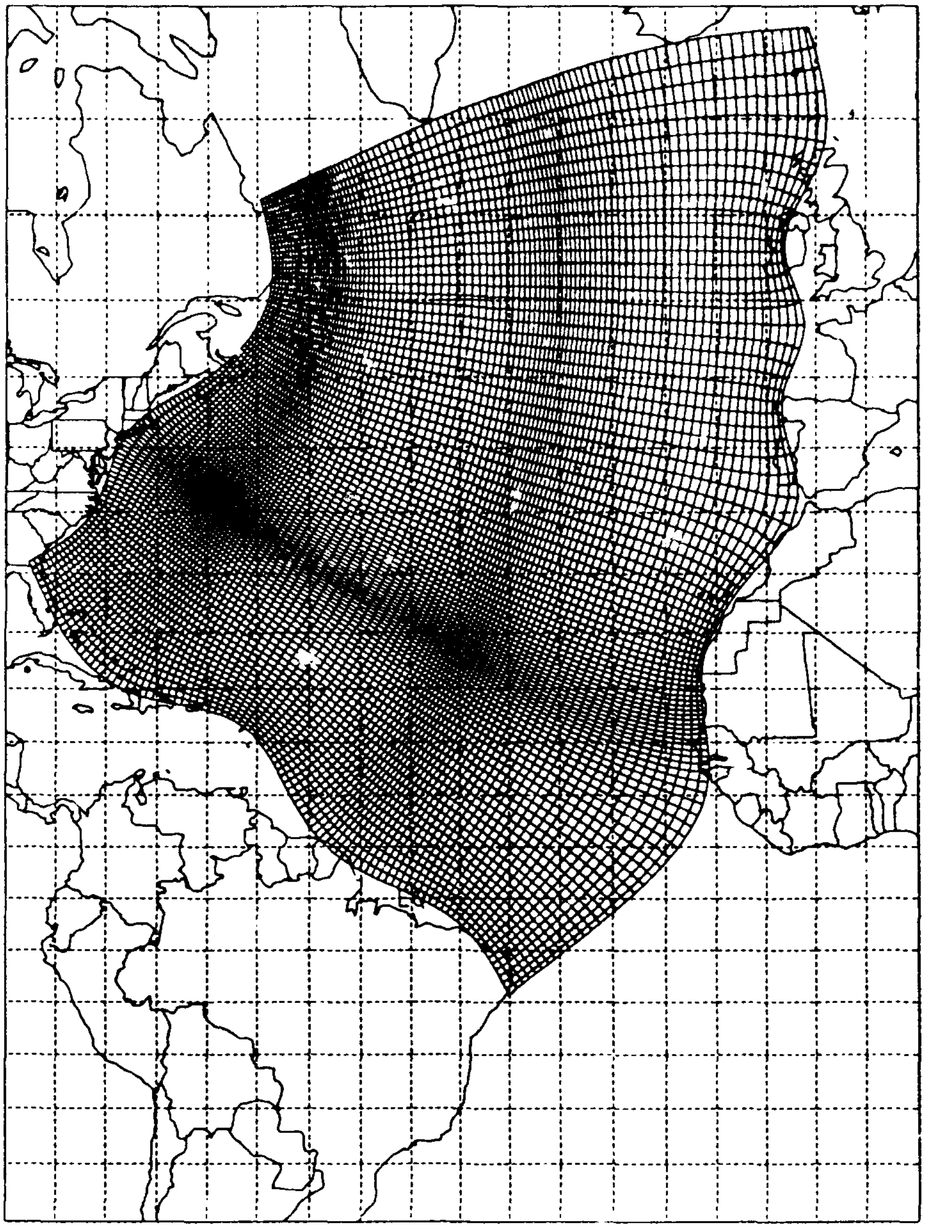
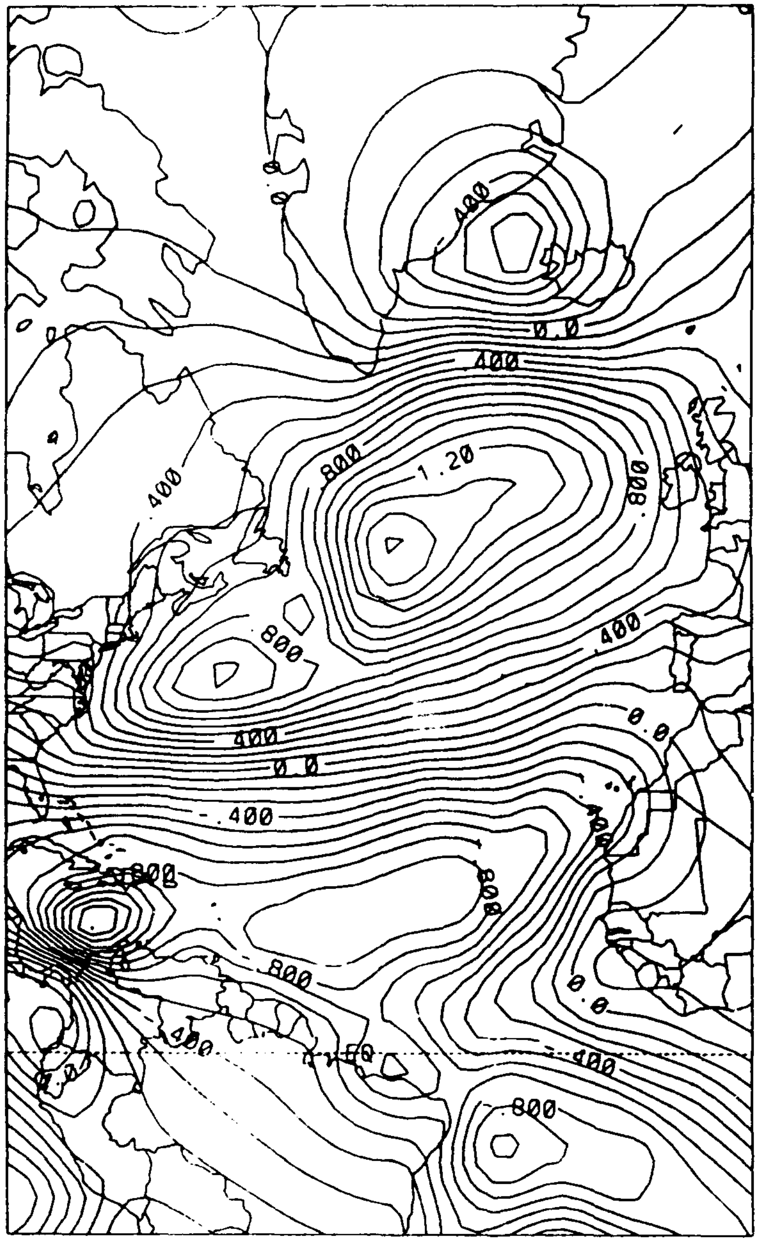


Figure 1

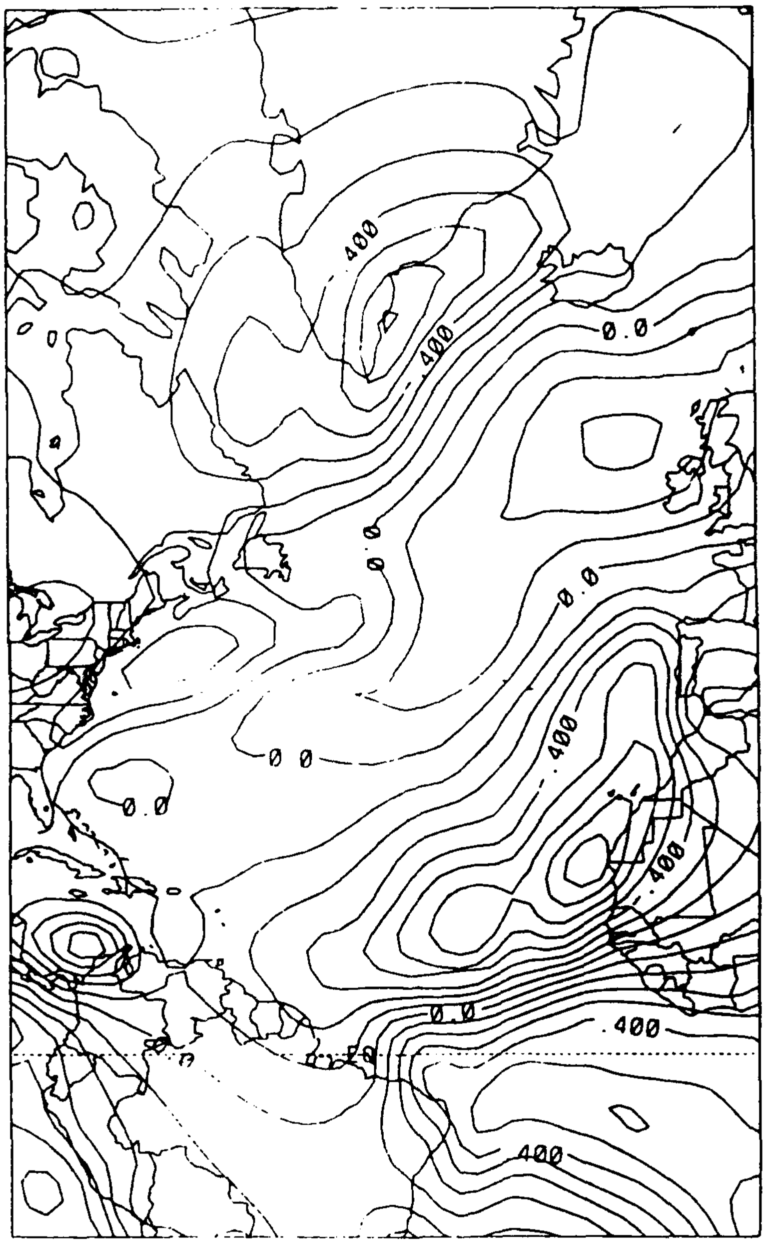
Original Wind X - Annual Mean



CONTOUR FROM -1.4000 TO 1.5000 CONTOUR INTERVAL OF 0.10000 PT(3,3)= -0.58362

Figure 2a

Original Wind Y - Annual Mean



CONTOUR FROM -0.80000 TO 0.70000 CONTOUR INTERVAL OF 0.10000 PT(3,3)= 0.62166

Figure 2b

Wind Vectors – Annual Mean

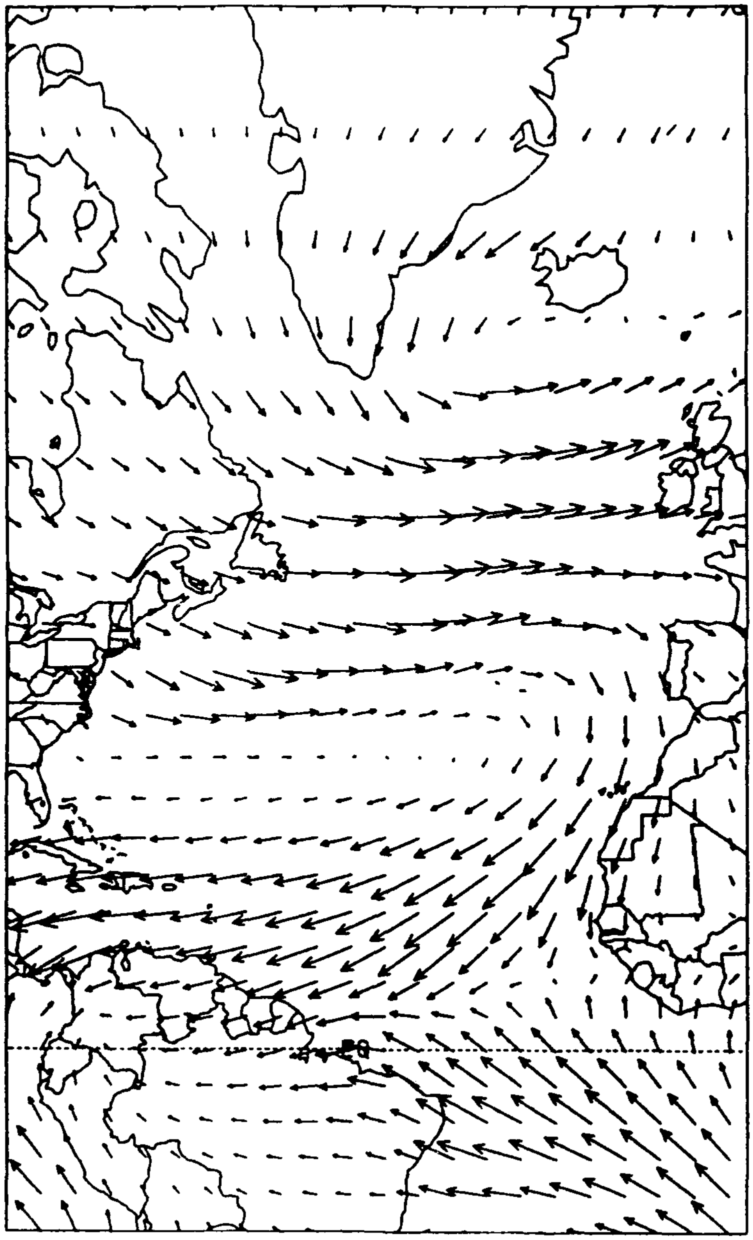
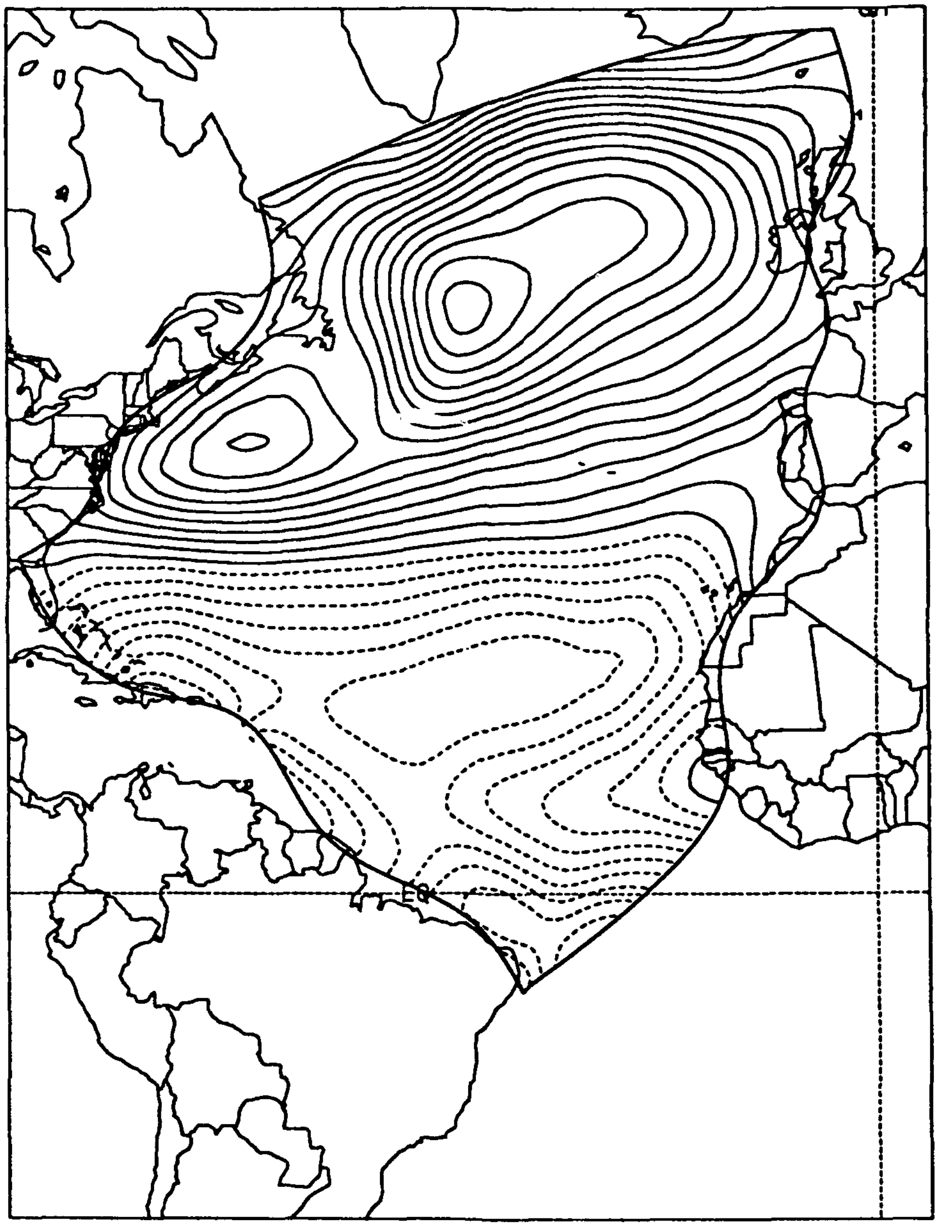


Figure 2c

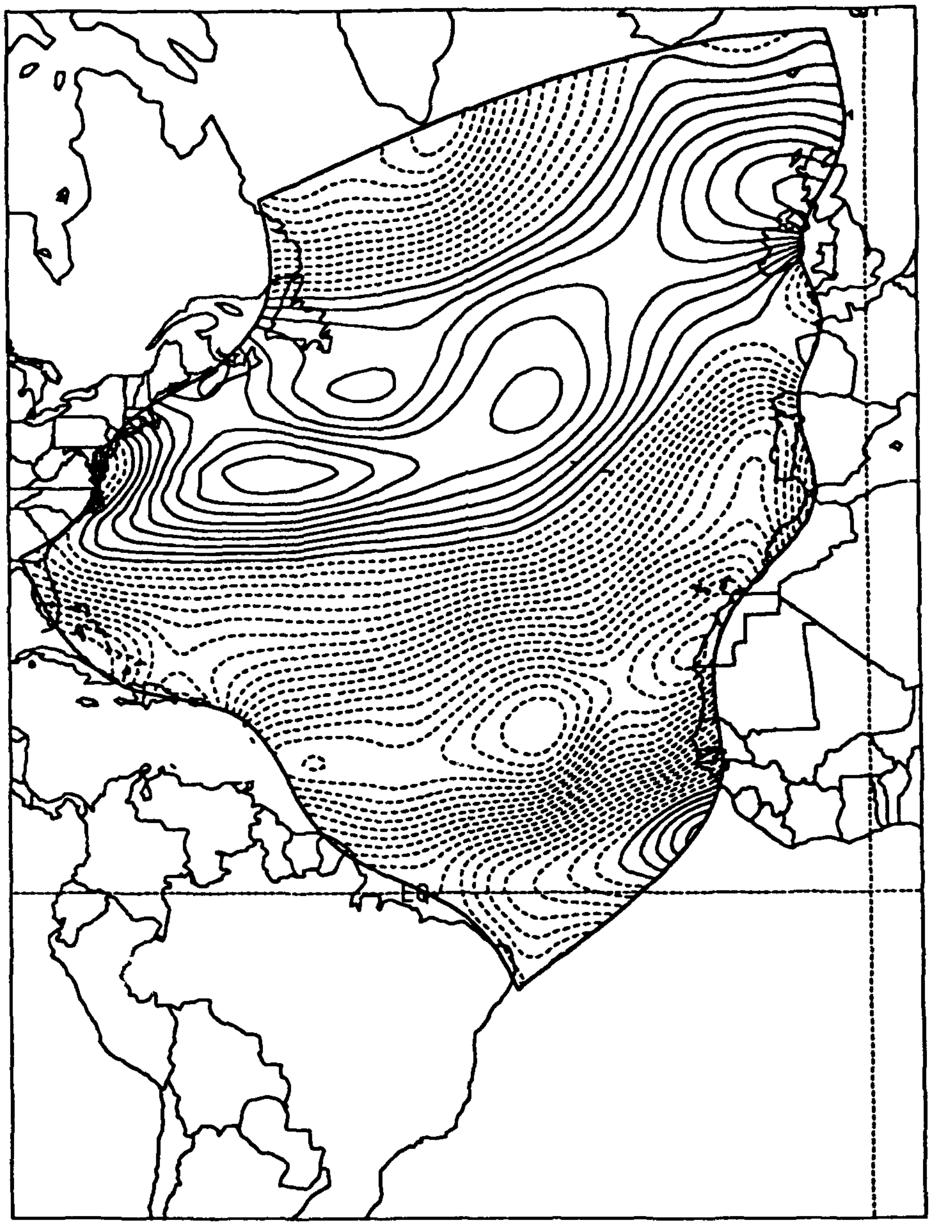
Wind X - Annual Mean



CONTOUR FROM -.000085 TO .000145 BY .00001

Figure 3a

Wind Y - Annual Mean



CONTOUR FROM -.0000975 TO .0000475 BY .000005

Figure 3b

Wind with magnitude– Annual Mean

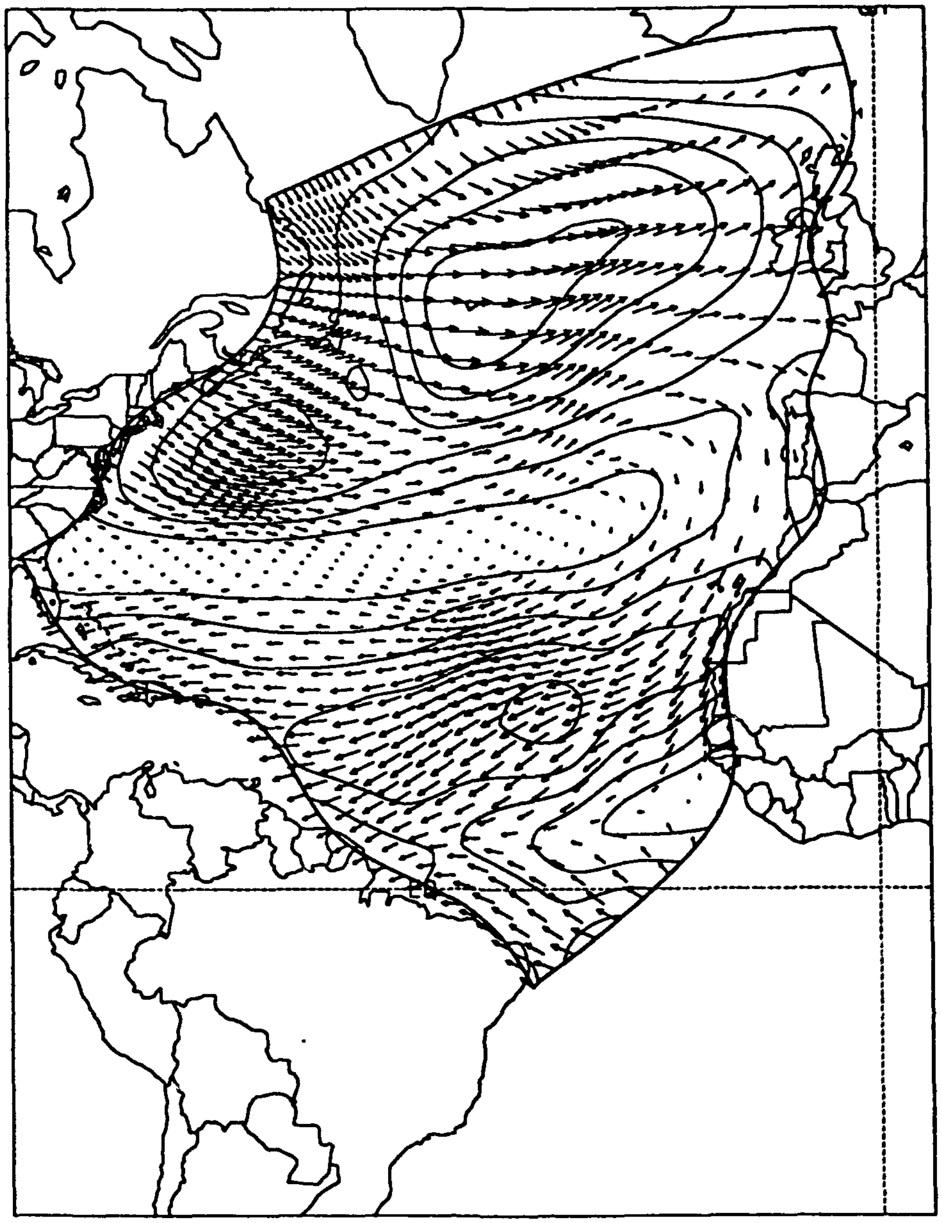
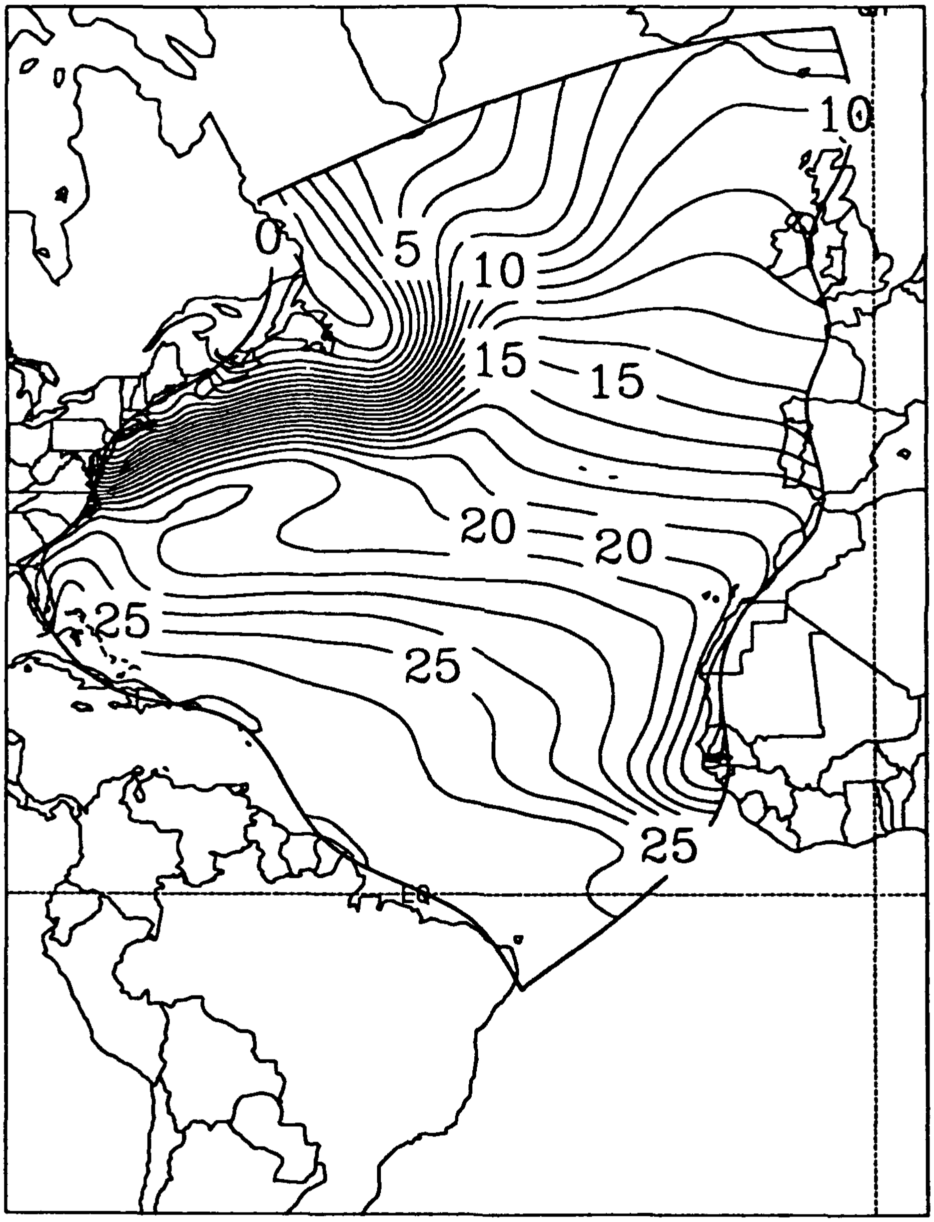


Figure 3c

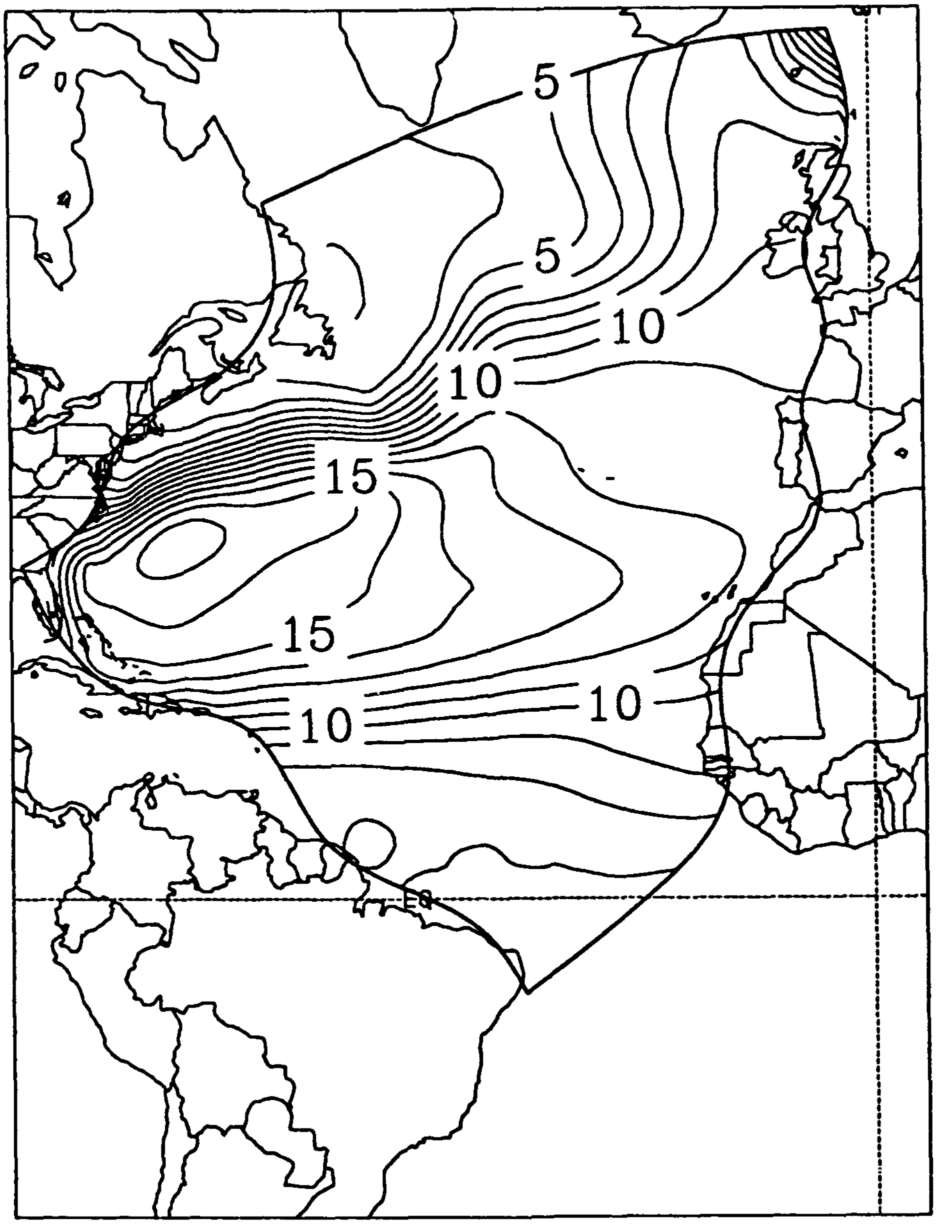
Temperature - level 4 50



CONTOUR FROM 0 TO 27 BY 1

Figure 4a(1)

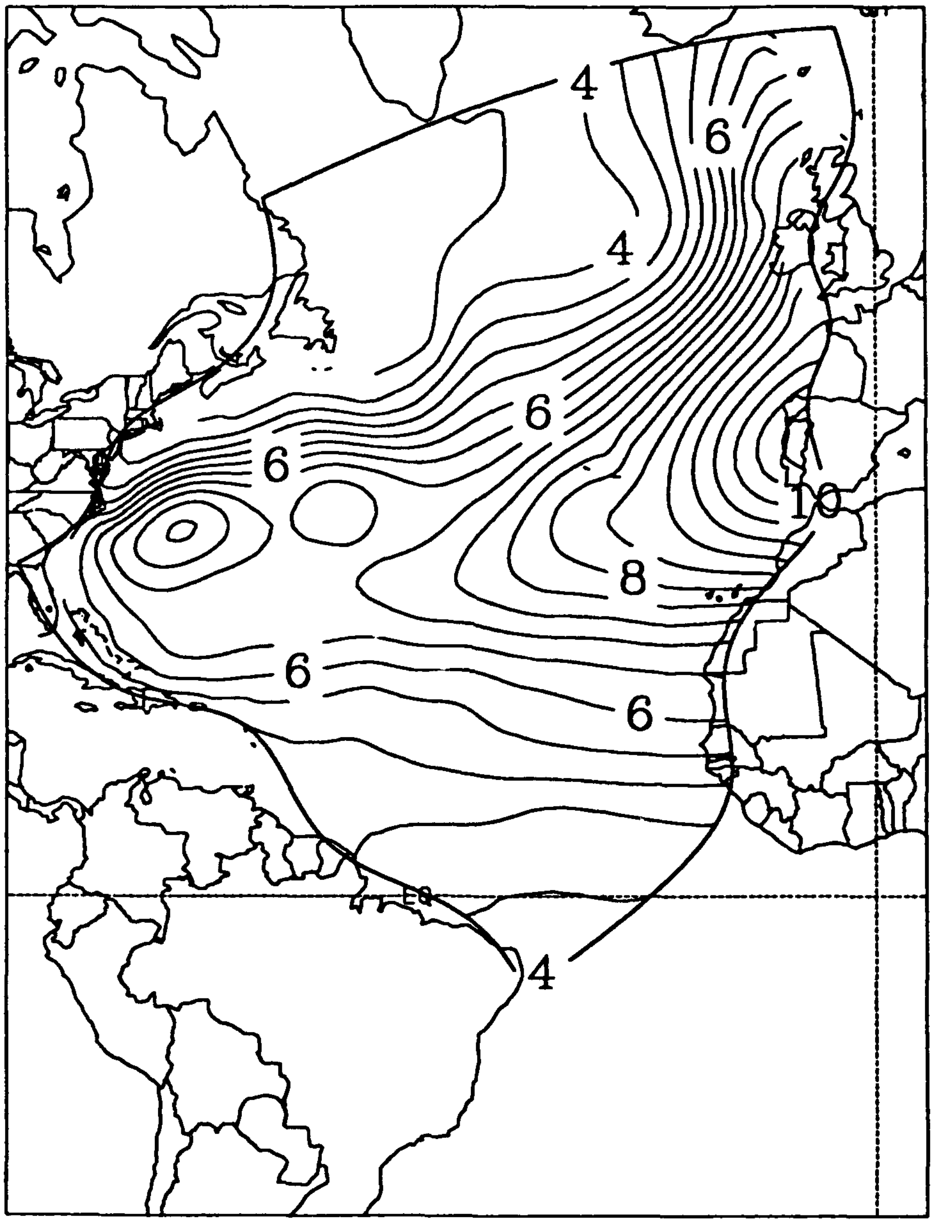
Temperature - level 13 500



CONTOUR FROM 2 TO 17 BY 1

Figure 4a(2)

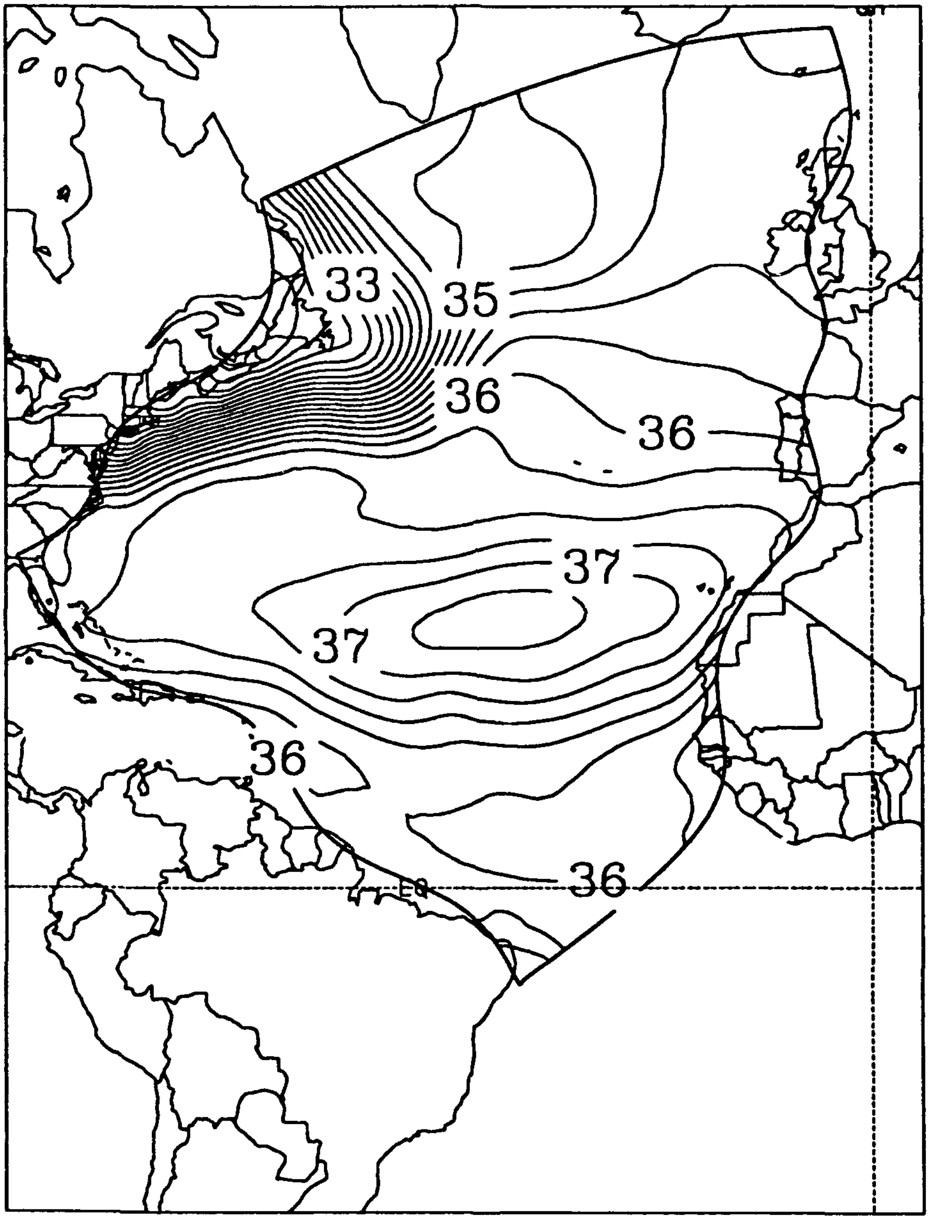
Temperature – level 18 1000



CONTOUR FROM 3.6 TO 10.8 BY .4

Figure 4a(3)

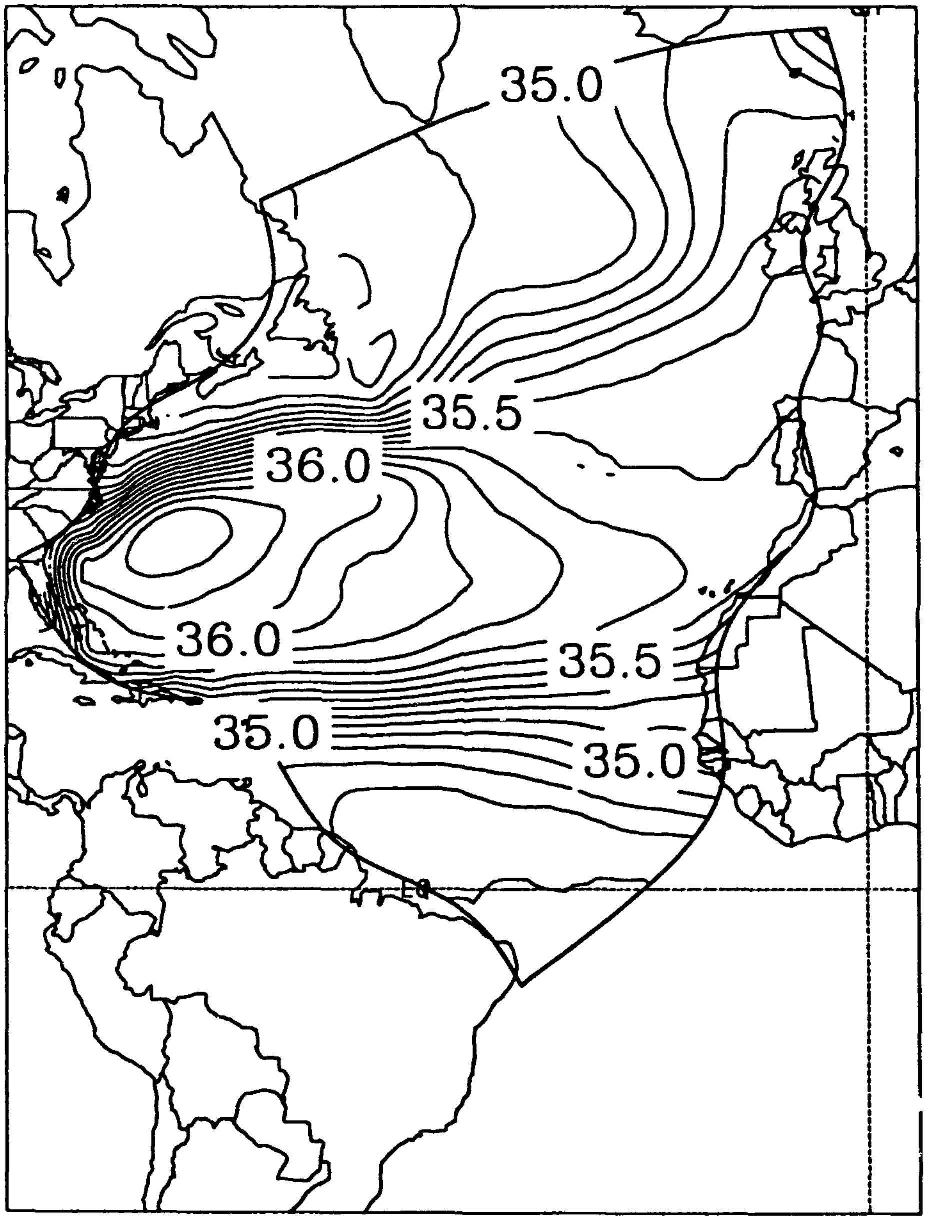
Salinity - level 4 50



CONTOUR FROM 31.75 TO 37.25 BY .25

Figure 4b(1)

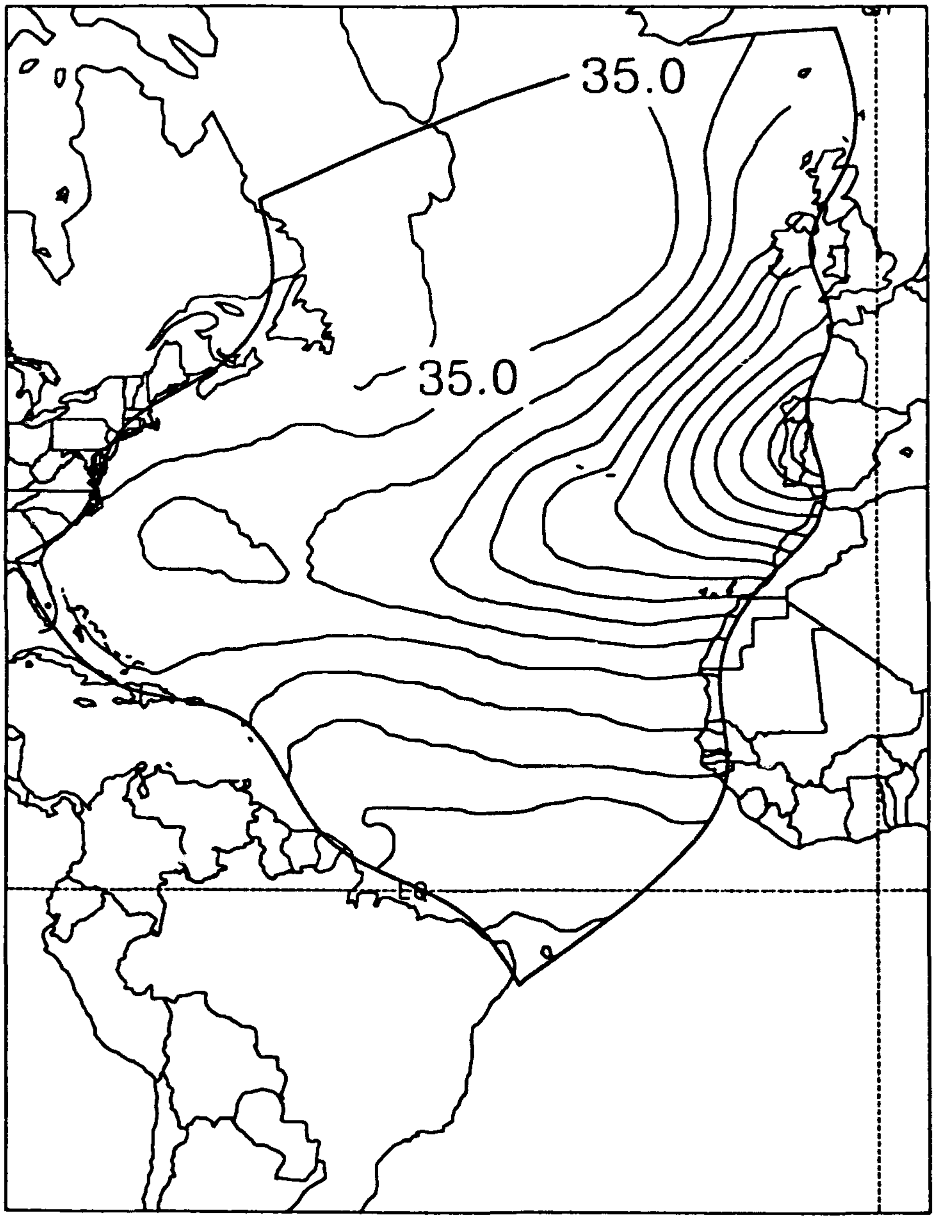
Salinity - level 13 500



CONTOUR FROM 34.6 TO 36.3 BY .1

Figure 4b(2)

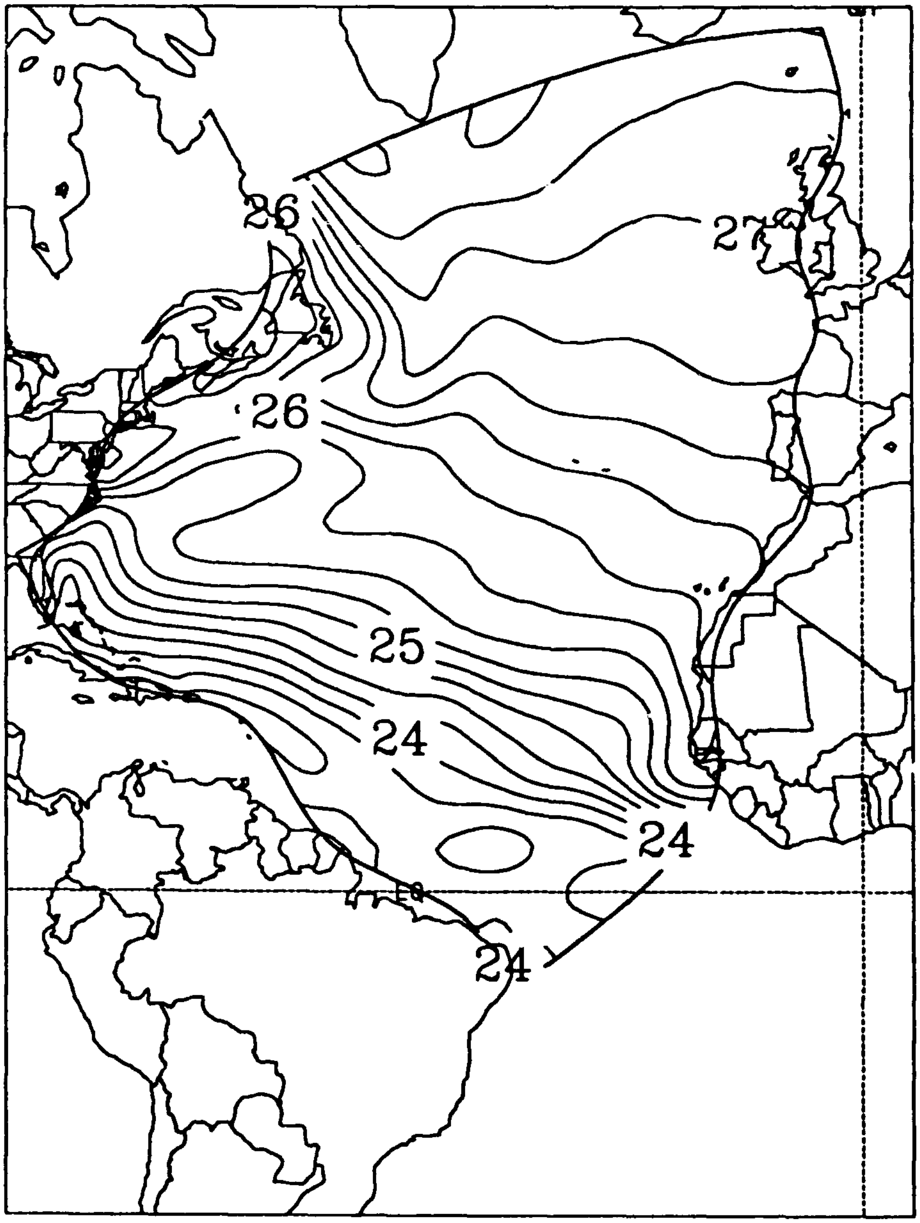
Salinity - level 18 1000



CONTOUR FROM 34.6 TO 36.2 BY .1

Figure 4b(3)

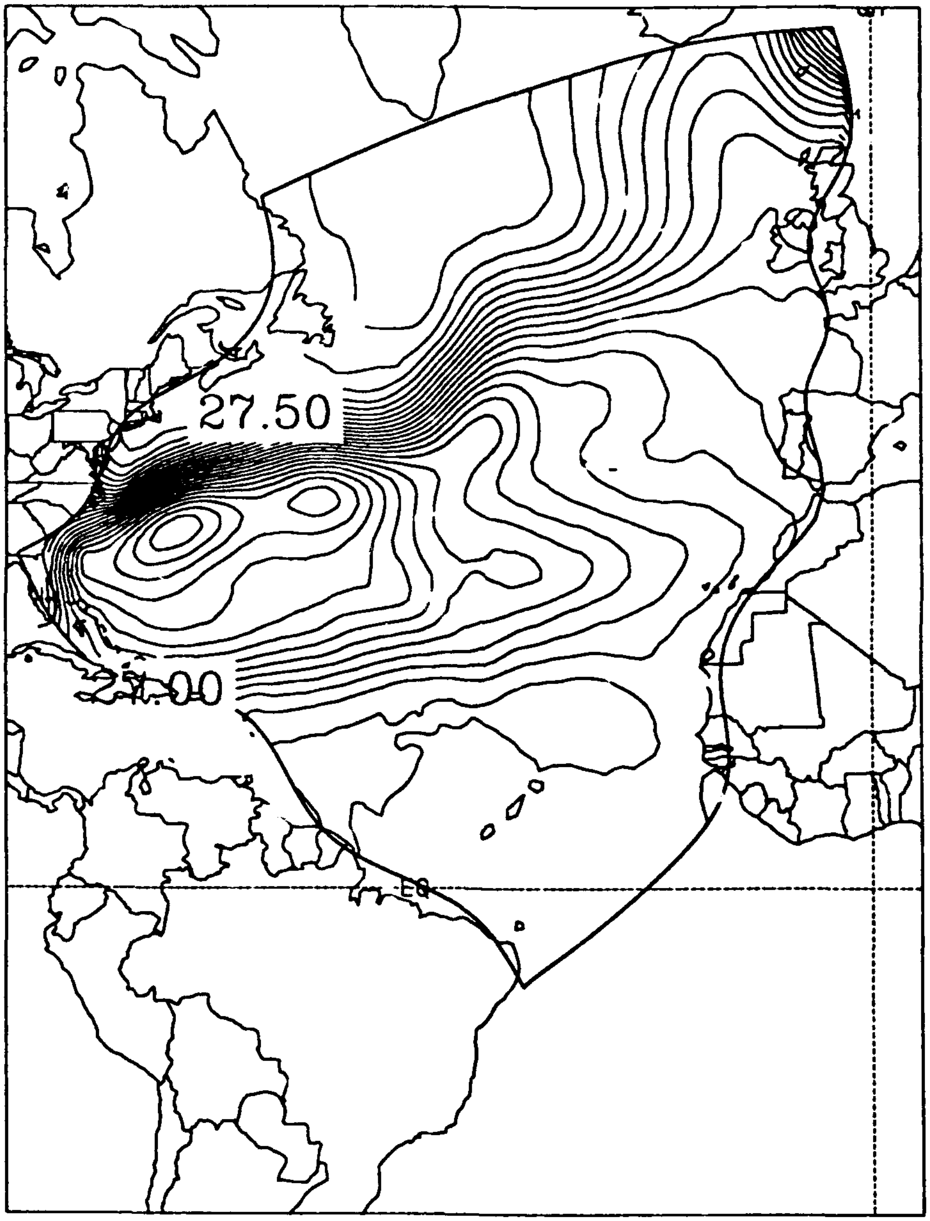
Density - level 4 50



CONTOUR FROM 23.5 TO 27.5 BY .25

Figure 4c(1)

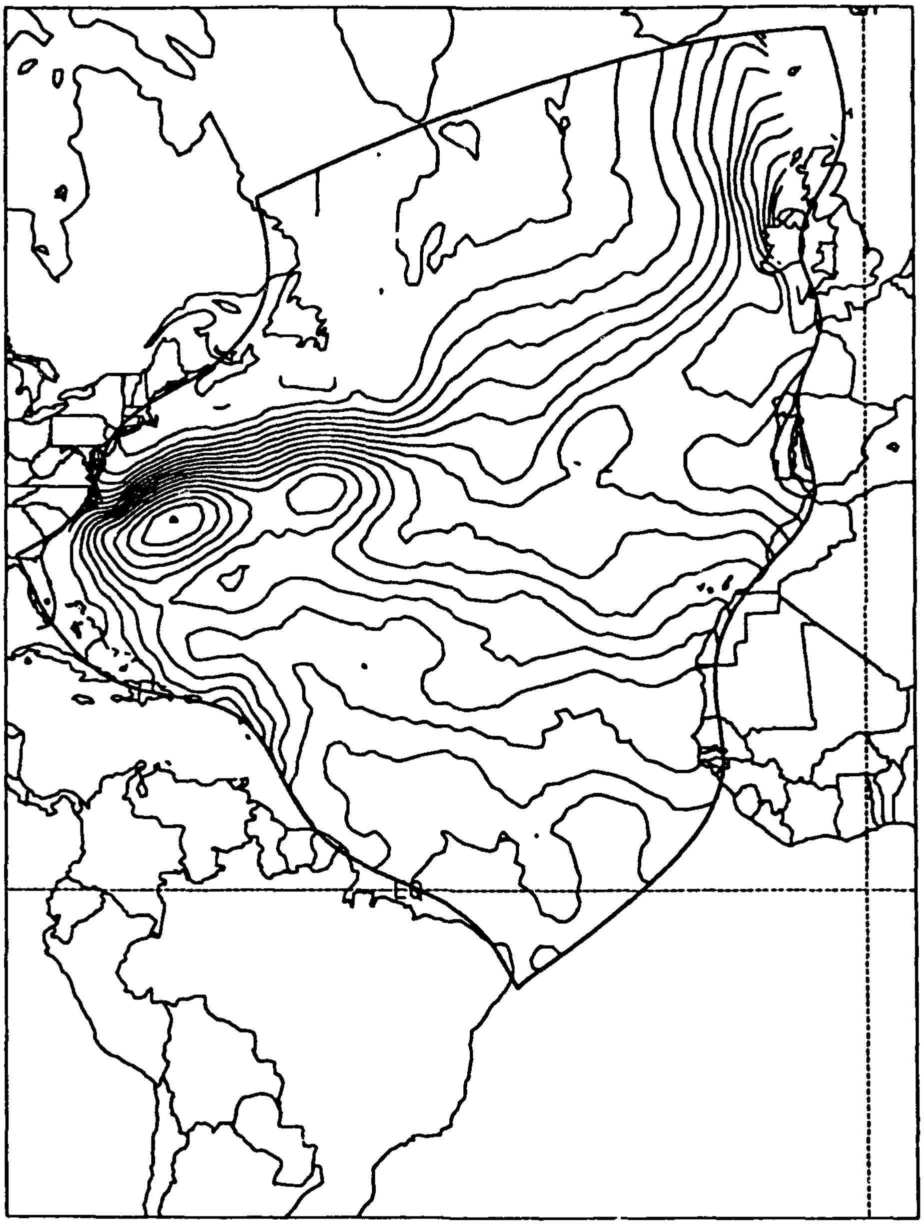
Density - level 13 500



CONTOUR FROM 26.5 TO 28 BY .05

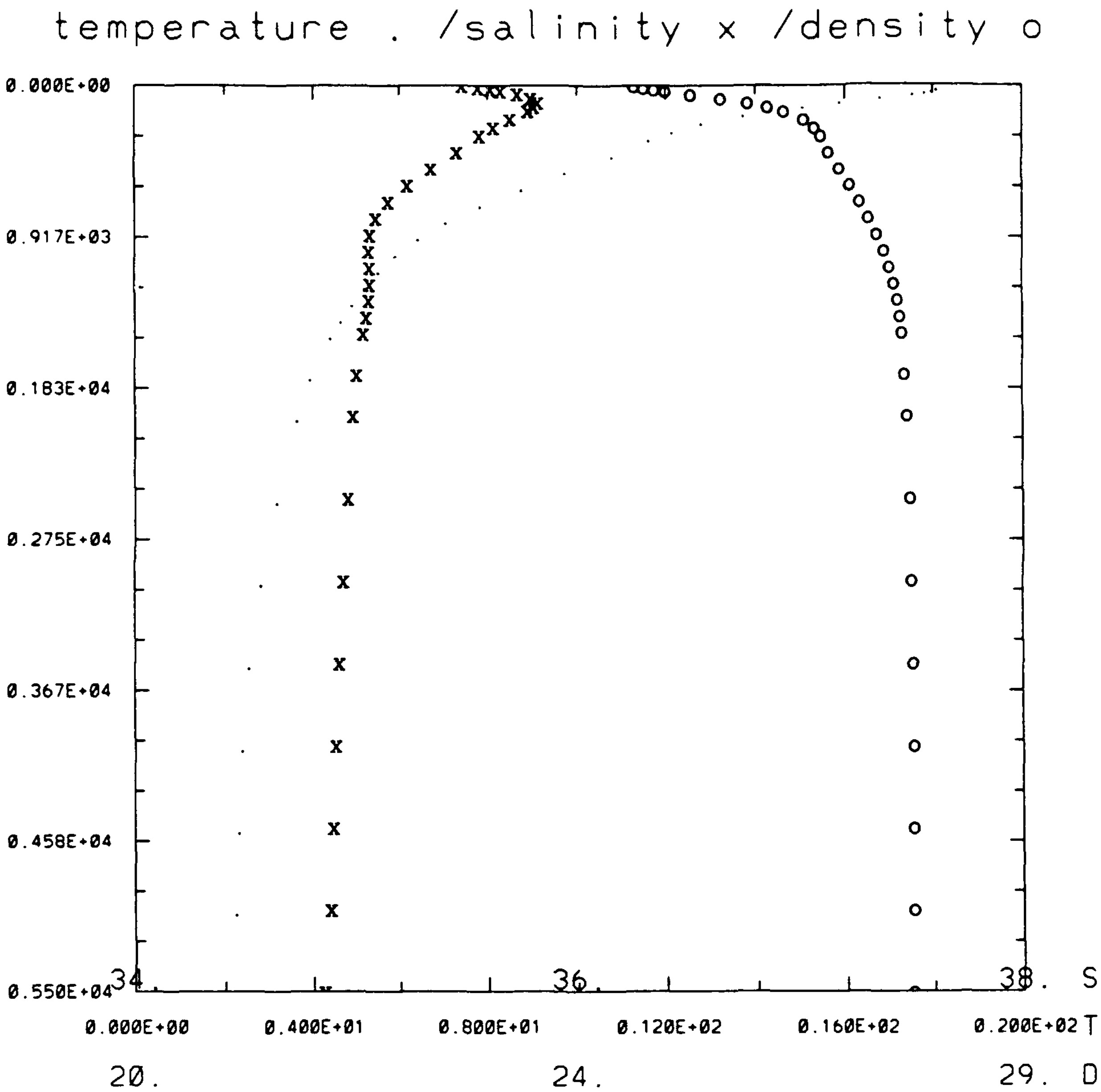
Figure 4c(2)

Density - level 18 1000



CONTOUR FROM 27.44 TO 27.76 BY .02

Figure 4c(3)



temperature . /salinity x /density o
0.000E+00
0.917E+03
0.183E+04
0.275E+04
0.367E+04
0.458E+04
0.550E+04
34.
36.
38.
S
0.000E+00
0.400E+01
0.800E+01
0.120E+02
0.160E+02
0.200E+02
T
20.
24.
29.
D

Figure 5

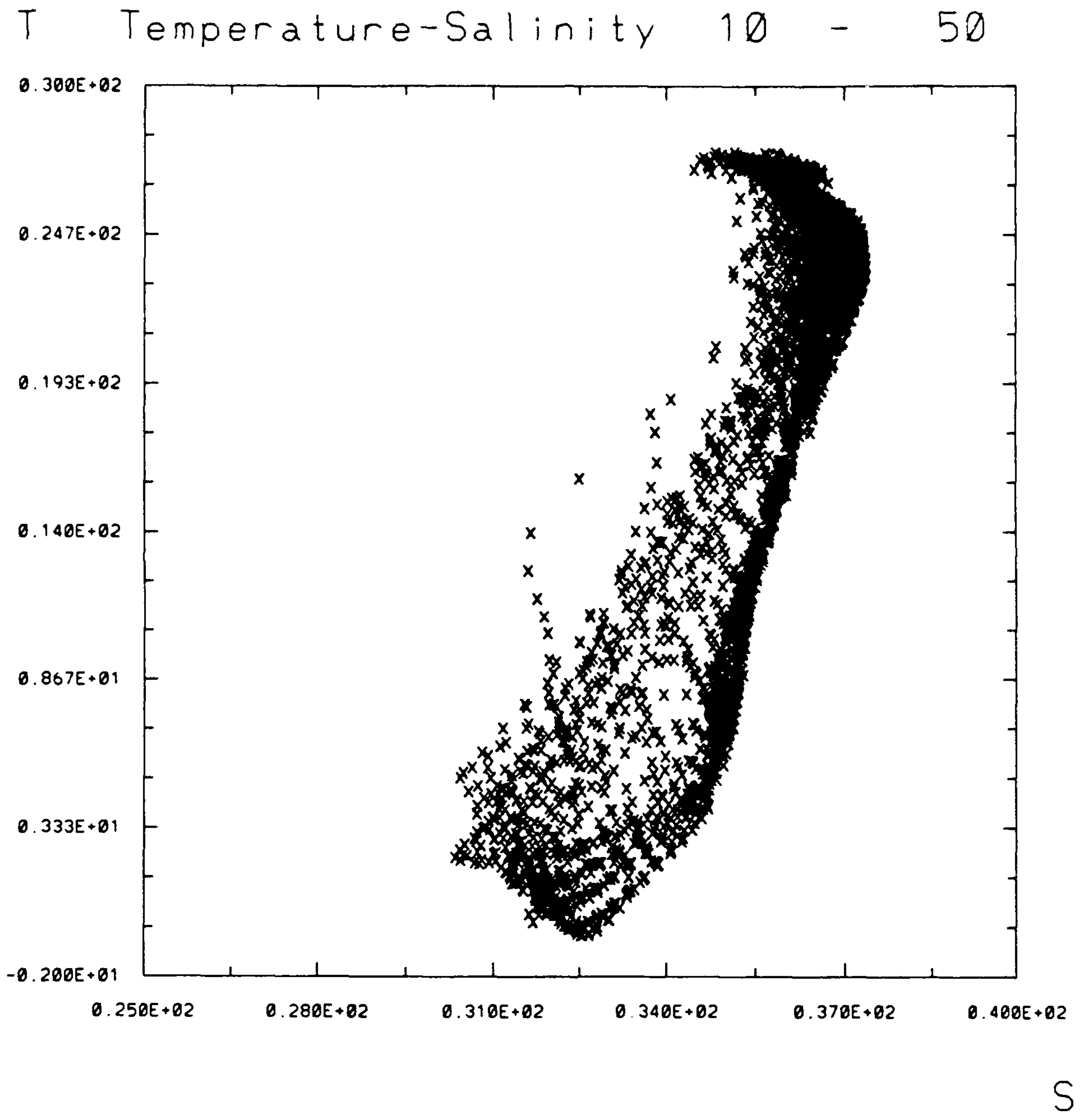
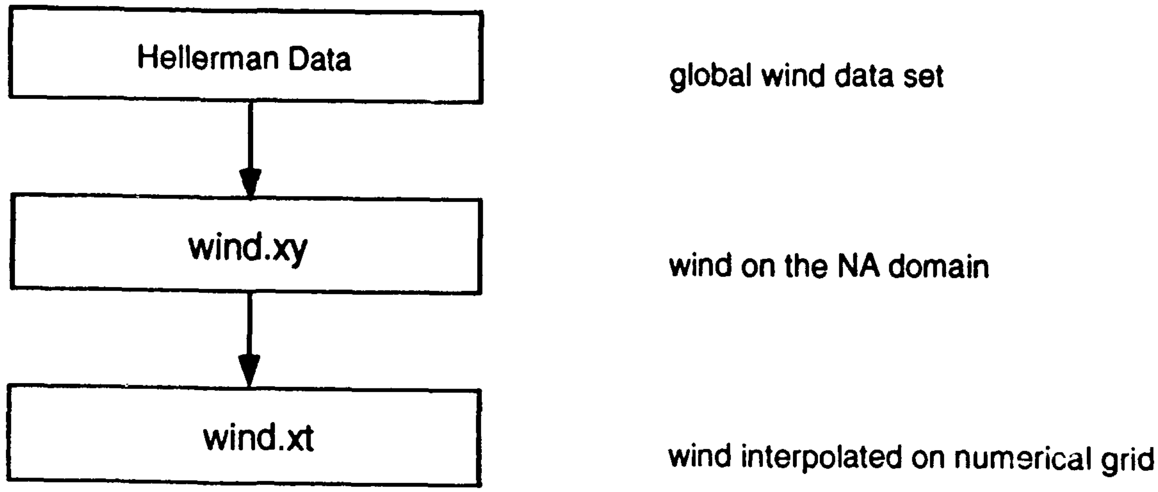

T Temperature-Salinity 10 - 50
0.300E+02
0.247E+02
0.193E+02
0.140E+02
0.867E+01
0.333E+01
-0.200E+01
0.250E+02
0.280E+02
0.310E+02
0.340E+02
0.370E+02
0.400E+02
S

Figure 6

Wind File Diagram



Levitus File Diagram

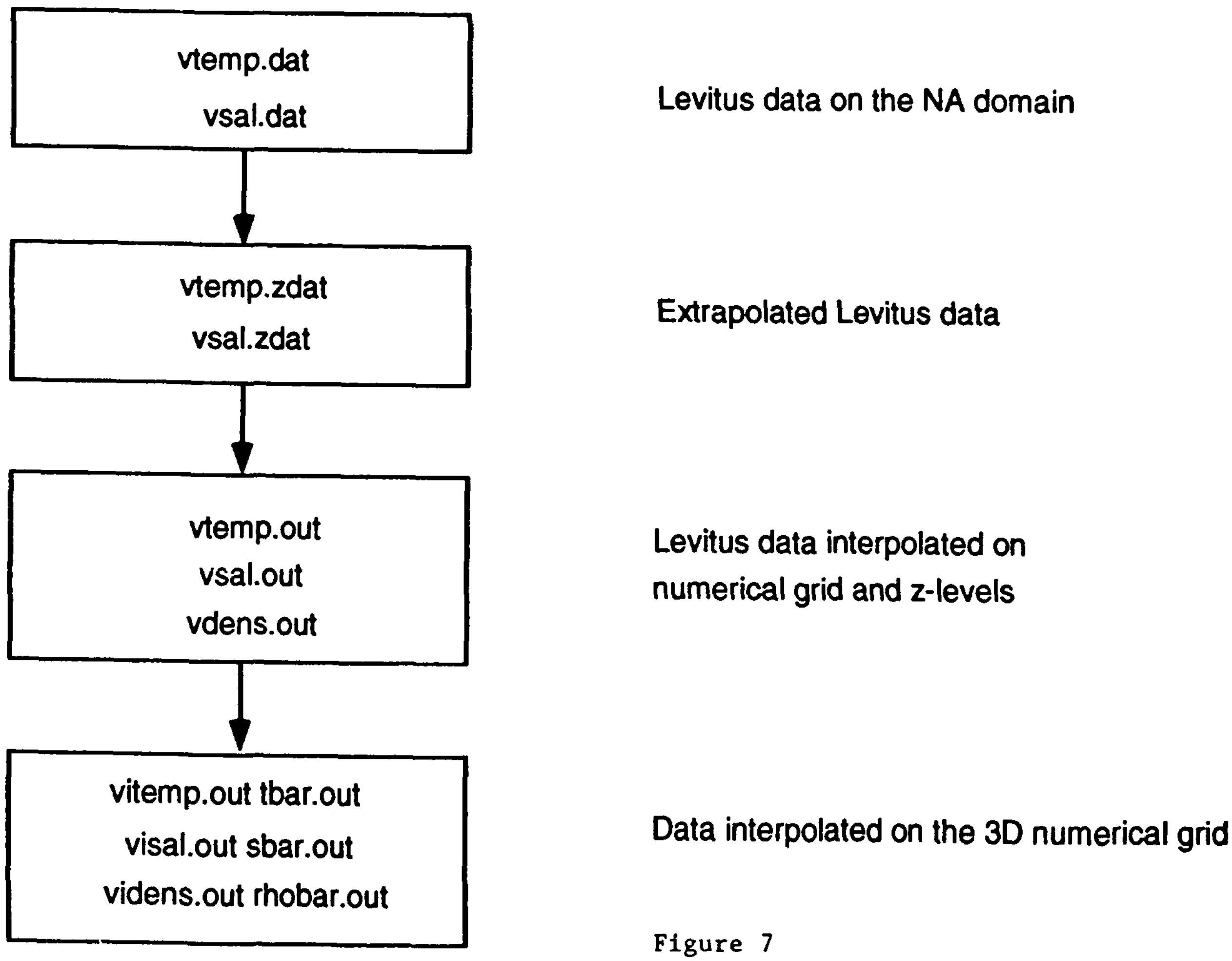


Figure 7

APPENDIX: USER'S MANUAL

This section describes the interpolation numerical procedures as well as what the user has to do to configure the programs. Changes that are the user's responsibility are concentrated in the parameter files of each program. Routines that are included in the procedures are also part of the NAUL. Files referred to as fort.* are created from the grid generation software. The diagrams of the files generated by the programs are depicted in Fig. 7.

A1: THE WIND PROCESSING PROGRAMS

1.1. PROGRAM: w3.f

The program writes a subset of the Hellerman winds for the NA. The selected lon/lat coordinates are written to a file. The dimension of the NA domain are written into indata2.par

Parameter file: w3.par

NN	number of data sets in input data file
L1 L2 M1 M2	selected lon/lat range for the NA, format 4(i4)
	L1,L2: lon range (max -179 to 179)
	M1,M2: lat range (max -89 to 89)
wind.d	input data file
wind.xy	NA wind data file
wind.ll	lon/lat coord of NA domain

Program expects $L1 < L2$, $M1 < M2$. If $L1 > L2$ program selects L1 to 179, then 1 to L2. If $M1 > M2$, program changes the order $M1 \& M2$, $M1 < M2$. The parameter file allows the parameters to be changed without recompiling.

Input file: wind.d format 6e13.6

This file contains the annual mean and 12 month wind data. For only one or more months, form the input file by concatenating from hr_ann_sm.d, m1.d, ..., m12.d, and change the

number of data sets in the parameter file to the appropriate number. The annual mean counts as one data set, as do each of the months.

Output files:	wind.xy	format e13.6
	wind.ll	format e13.6
	indata2.par	parameter file

1.2. PROGRAM: r2.f

This program extracts the numerical grid lon/lat coordinates from the input file.

Parameter file: grid2.par

L	size in x direction of numerical grid
M	size in y direction of numerical grid

Input file: fort.62

Output file: spem.ll format e13.6

1.3. PROGRAM: bilw.f

This program performs bilinear interpolation of the wind components onto the numerical grid. The interpolated vectors then need to be adjusted to the numerical (ξ, η) orthogonal coordinate axes.

Parameter file: grid.par (cfr. r2.f)

Parameter file: indata2.par

NX	size in x direction of NA domain
NY	size in y direction of NA domain

Parameter file: bilw.par

wind.xy	NA wind component data file
wind.ll	NA domain lon/lat data file
spem.ll	numerical grid lon/lat data file
wind.xt	interpolated output data file

Input files: wind.xy
wind.ll
spem.ll
fort.60 (needed for axes adjustment)

Output file: wind.xt format 12(e12.6)

Routine: trgd2d (2-D bilinear interpolation)

1.4. PROGRAM: wl1.f

This program creates the **gmeta** plotfile (contours and/or vectors) for the NA wind data sets.

Compile using: f77 -c -03 -cg89 -o wl1.o wl1.f

ncargf77 -cg89 -u -o wlplot.exe wl1.o

Parameter file: indata2.par (cfr. bilw.f)

Parameter file: wl1.par

NN	number of months selected
A A A A A	plot contour options
	X plots X contours
	Y plots Y contours
	V plots vectors
	P plots vector magnitude & direction
wind.xy	input data file
NNN	selected months (in ascending order)
.	

Running wlplot.exe again with a modified parameter file wl1.par will create a new gmeta plotfile.

Input file: wind.xy

Output file: gmeta

1.5. PROGRAM: wi1.f

This program creates the **gmeta** plotfile (contours and/or vectors) for the wind data sets interpolated on the numerical grid.

Compile using: f77 -c -03 -cg89 -o wi1.o wi1.f

ncargf77 -cg89 -u -o wiplot.exe wi1.o plots.o saxpy.o grafs.o

Parameter files: grid2.par (cfr. r2.f)

wl1.par (cfr. wl1.f)

Running wiplot.exe again with a modified parameter file wi1.par will create a new gmeta plotfile.

Input files: wind.xt
fort.3

Output file: gmeta

Routines: NCAR graphics
cpshift (for contours)
velvct (for vectors)

A2: THE LEVITUS DATA PROCESSING PROGRAMS

2.1. PROGRAM: gll.f

This program prepares the lon/lat coord file for the Levitus data restricted on the NA domain. The values of NX, NY (size of the NA domain) are written to indata3.par.

Parameter file: gll.par

L1 L2 M1 M2	selected lon/lat range, format 4(i4) L1, L2: lon range (max -179 to 179) M1, M2: lat range (max -89 to 89)
lev1.ll	lon/lat coordfile of selected data

Output files:	lev1.ll	format e13.6
	indata3.par	parameter file

2.2. PROGRAM: zgi.f

This program performs zgrid interpolation (on regular grid) of the 3-D Levitus temperature/salinity data.

Parameter file: indata3.par

NX	size in x direction of Levitus NA domain
NY	size in y direction of Levitus NA domain

Parameter file: zgi.par

vtemp.dat	input data file
vtemp.zdat	extrapolated data file

Input file:	vtemp.dat or vsal.dat	format 8f10.2
Output file:	vtemp.zdat or vsal.zdat	format f10.2
Routine:	zgrid (2-D interpolation)	

2.3. PROGRAM: bilt.f

This program performs horizontal (bilinear) 2-D interpolation of the data on the numerical grid.

Parameter files: indata3.par (cfr. trn.f)

Parameter file: grid3.par

L	size in x direction of numerical grid
M	size in y direction of numerical grid

Parameter file: bilt.par

vtemp.zdat	input data file
lev1.ll	input lon/lat coordfile
spem.ll	numerical grid lon/lat coordfile (cfr. r2.f)
vtemp.zout	interpolated output data file

Input files: vtemp.zdat or vsal.zdat format f10.2
lev1.ll
spem.ll
fort.3

Output file: vtemp.zout or vsal.zout	format	i3	e13.6	12(e12.6)
		level	mean	data

Routine: trgd2d (2-D bilinear interpolation)

2.4. PROGRAM: rh1.f

This program computes the density from temperature and salinity 2-D interpolated data.

Parameter file: grid3.par (cfr. bilt.f)

Parameter file: rh1.par

vtemp.zout	2-D interpolated temperature data file
vsal.zout	2-D interpolated salinity data file

vdens.zout	density output data file

Input files: vtemp.zout
vsal.zout

Output file:	vdens.zout	format	i3	e13.6	12(e12.6)
			level	mean	data

2.5. PROGRAM: vit1.f

This program performs vertical (spline) interpolation of the 3-D data on the numerical grid.

Parameter file: grid3.par (cfr. bilt.f)

Parameter file: vinterp.par

XX	parameter h_c
XX	parameter θ
N	number of levels in model

Parameter file: vit1.par

vtemp.zout	interpolated (horizontal) input data file
vitemp.zout	vertically interpolated output data file
vitbar.zout	vertically interpolated basic state data file

Input files: vtemp.zout, vsal.zout, or vdens.zout
fort.3

Output file: vitemp.zout, visal.zout, or videns.zout format 12(e12.6)
vitbar.zout, visal.zout,or vidbar.zout

Routine: splint (spline interpolation)

2.6. PROGRAM: tl1.f

This program creates **gmeta** plotfile (contours) for the Levitus temperature and salinity data on the NA domain.

Compile using: f77 -c -03 -cg89 -o tl1.o tl1.f

ncargf77 -cg89 -u -o tlplot.exe tl1.o

Parameter file: indata3.par (cfr. gll.f)

Parameter file: tl1.par

NN	number of levels selected
A	T for temperature, S for salinity
vtemp.zdat	input data file
NNNN	selected levels (ascending order, in meters)
.	

Running tlplot.exe again with a modified parameter file tl1.par will create a new gmeta plotfile.

Input file: vtemp.zdat or vsal.zdat

Output file: gmeta

Routines: NCAR graphics
cpcnrc

2.7. PROGRAM: ti1.f

This program creates **gmeta** plotfile (contours) for data sets interpolated on the numerical grid.

Compile using: f77 -c -03 -cg89 -o ti1.o ti1.f

ncargf77 -cg89 -u -o tiplot.exe ti1.o plots.o saxpy.o

Parameter file: grid3.par (cfr. bilt.f)

Parameter file: til.par

NN	number of levels selected
A	T for temperature, S for salinity
vtemp.zout	interpolated input data file
NNNN	selected levels (ascending order, in meters)
.	

Running tiplot.exe again with a modified parameter file til.par will create a new gmeta plotfile.

Input files: vtemp.zout or vsal.zout
fort.3

Output file: gmeta

Routines: NCAR graphics
cprect

2.8. PROGRAM: cil.f

Interactive program, creates **color gmeta** plotfile (contours) for the data interpolated on the numerical grid.

Compile using:
```
f77 -c -03 -cg89 -o cil.o cil.f
ncargf77 -cg89 -u -o ciplot.exe cil.o plots.o saxpy.o
```

Parameter file: grid3.par (cfr. bilt.f)

Parameter file: cil.par

NN	number of levels selected
NNNN	selected levels (ascending order, in meters)
.	

Running ciplot.exe again with a modified parameter file cil.par will create a new gmeta plotfile.

Input file: vtemp.zout, vsal.zout, or vdens.zout

Program prompts for following:

A	t (temperature), s (salinity), or r(density)
A(30)	data filename
A(26)	title of plot
NNN	minimum contour level
NNN	maximum contour level

Different color scales are used for temperature and salinity:

t: grey/blue/green/red; s, or r: yellow/green/red/brown

The maximum/minimum contour levels specify the range of contour values to be plotted. These need not correspond to the max/min of the data If 0 is entered for both max and min contour levels, then the program uses the data max and min. Max/min data and label values for the contours are dumped to file cil.out.

Output files: gmeta
cil.out

2.9. PROGRAM: dts.f

This program creates a 'gmeta' plotfile of the vertical profile of temperature, salinity, and density basic state distribution.

Compiled using: f77 -c -03 -cg89 -o dts.o dts.f

ncargf77 -cg89 -u -o dtsplot.exe dts.o

Parameter file: grid3.par (cfr. bilt.f)

Parameter file:	dts.par	
vtemp.zout		temperature data file
vsal.zout		salinity data file
vdens.zout		density data file

Input files: vtemp.zout
vsal.zout
vdens.zout

Output file: gmeta

2.10. PROGRAM: ts1.f

This program creates a T-S diagram for the 2-D interpolated data sets on z-levels.

Compile using: f77 -c -03 -cg89 -o ts1.o ts1.f

ncargf77 -cg89 -u -o tsplot.exe ts1.o

Parameter file: grid3.par (cfr. bilt.f)

Parameter file:	gplot.par	
XL		minimum salinity plotted
RX		maximum salinity plotted
BY		minimum temperature plotted
TY		maximum temperature plotted

Parameter file:	ts1.par	
NN		interval between points plotted if 1, every point in data files is plotted
NNNN		minimum depth (in meters) of point plotted
NNNN		maximum depth (in meters) of points plotted
vtemp.ozut		interpolated temperature data
vsal.zout		interpolated salinity data

Input files: vtemp.zout
vsal.zout

Output file: gmeta

DISTRIBUTION LIST

Scientific Officer Code: 453
Robert A. Peloquin (3)
Office of Naval Research
800 North Quincy Street
Arlington, VA 22217-5000

Administrative Grants Officer
Office of Naval Research
Resident Representative N66020
Administrative Contracting Officer
Georgia Institute of Technology
206 O'Keefe Building
Atlanta, GA 30332-0490

Director, Naval Research Laboratory
Attn: Code 2627
Washington, D. c. 20375

Defense Technical Information Center (2)
Building 5, Cameron Station
Alexandria, VA 22304-6145

Donald R. Cotten, Director
Research and Sponsored Programs
The University of Southern Mississippi
Southern Station Box No. 5157
Hattiesburg, MS 39406-5157

Dr. Stephen A. Doblin, Dean
Science and Technology
The University of Southern Mississippi
Southern Station Box No. 5165
Hattiesburg, MS 39406-5165

Dr. James W. Meredith
Director, Center of Higher Learning
Building 1103, Room 103
Stennis Space Center, MS 39529

Dr. A. Louise Perkins
Scientific Computing Program
The University of Southern Mississippi
Building 1103, Room 103
Stennis Space Center, MS 39529

Dr. Grayson Rayborn
Director of the School of Mathematical Sciences and the Scientific Computing Program
The University of Southern Mississippi
Building 1103, Room 103
Stennis Space Center, MS 39529

Dr. Benjamin R. Seyfarth
Assistant Professor, Computer Science
The University of Southern Mississippi
Southern Station Box No. 5106
Hattiesburg, MS 39406-5106

Dr. Karen M. Yarbrough
Vice President for Research and Planning
The University of Southern Mississippi
Southern Station Box No. 5116
Hattiesburg, MS 39406-5116

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. Agency Use Only *(Leave blank).*

2. Report Date.
October 1993

3. Report Type and Dates Covered.
Technical Memo

4. Title and Subtitle.
Processing of Climatological Data for Model Initialization

5. Funding Numbers.
Program Element No.
Project No.
Task No.
Accession No.

6. Author(s).
Germana Peggion
Grace Foo

7. Performing Organization Name(s) and Address(es).
Center for Ocean & Atmospheric Modeling
The University of Southern Mississippi
Building 1103, Room 249
Stennis Space Center, MS 39529-5005

8. Performing Organization Report Number.
TM-2/94

9. Sponsoring/Monitoring Agency Name(s) and Address(es).
Office of Naval Research
Code 1513: RKL
Ballston Tower One
800 N. Quincy Street
Arlington, VA 22217-5660

10. Sponsoring/Monitoring Agency Report Number.

11. Supplementary Notes.
ONR Research Grant No. N00014-92-J-4112

12a. Distribution/Availability Statement.
Approved for public release; distribution is unlimited.

12b. Distribution Code.

13. Abstract *(Maximum 200 words).*
This document describes and documents a numerical procedure to compile data sets to be applied in the North Atlantic (NA) basin-wide numerical simulations. The specific objectives are:

1. to acquire climatological data sets for the NA and archive them in a data library
2. to develop an interpolation procedure for 2-D and 3-D data fields from a regular grid into the generalized coordinate system adopted by the ocean models
3. to prepare plotting facilities for the display and presentation of the original and interpolated data sets

14. Subject Terms.
(U) CLIMATOLOGICAL DATA, (U) MODEL INITIALIZATION, (U) NORTH ATLANTIC BASIN EDDY-RESOLVING MODELS

15. Number of Pages.
44

16. Price Code.

17. Security Classification of Report.	18. Security Classification of This Page.	19. Security Classification of Abstract.	20. Limitation of Abstract.
Unclassified	Unclassified	Unclassified	SAR